Physics of Galaxies

ANSWERS: HW SET NUMBER 1

1. a is semi-major axis, b is semi-minor axis, n=[10 e]= [10 (1-b/a)], where e is ellipticity and square brackets refer to integer part **[2 marks].**

For the left figure n=[10 e]= [10 (1-45mm/45mm)]=0, thus this is E0

For the middle figure n=[10 e]= [10 (1-13mm/45mm)]=7, thus this is E7

For the right figure n=[10 e]= [10 (1-27mm/45mm)]=4, thus this is E4 **[3 marks]**

Sa→Sc size of bulge decreases,

SBa→SBc size of bar decreases,

In the both cases winding of spiral arms decreases **[3 marks].**

2. We have

$$H_o = h \times \frac{100 \times 10^3 \left(\mathrm{m\,s^{-1}}\right)}{3.1 \times 10^{22} \left(\mathrm{m}\right)} = h \times 3.2 \times 10^{-18} \mathrm{s^{-1}}$$

so that

$$\frac{1}{H_o} = \frac{1}{h} \times \frac{10^{18}}{3.2 \times 3.2 \times 10^7}\, yr \approx \frac{10^{10}}{h}\, yr$$

[2 marks]

Hubble measured h to be 5, giving H_o^{-1} – which is roughly the age of the universe – as 2×10^9 yr, less than the age, for example, of globular clusters in the Galaxy, which is problematic. **[2 marks]**

3. Assuming the observer is in the midplane, the pathlength through the dust for a source at Galactic latitude b is x =h/sin(b)=h cosec(b). The flux is therefore reduced from F_0 (the value without extinction) to

$F = F_0 \exp(- k h \operatorname{cosec} b)$ [1 mark]

The apparent magnitude is then changed by

$m - m_o = - 2.5 \log_{10}(F/F_o)$

$= - (2.5/\log_e 10) \log_e(F/F_o)$

$= 1.09\, kh \operatorname{cosec} b.$ [3 marks] **[**1+3=**4 marks]**

[Note $\log_a x = \log_b x / \log_b a$]

[Total marks available 16]